6.13 AMBER, Astronomical Multi-BEam combineR

AMBER is a near-infrared, multi-beam interferometric instrument, combining up to 3 telescopes simultaneously. AMBER can be used in Period 84 with UTs or ATs. For specifications of the UT and AT performances see Sect. 4.2.2 and Sect. 4.2.5. All possible triplets of UTs are available, and a number of selected AT combinations. For the telescope positions and baseline lengths of the different AT and UT baselines, please refer to **the VLTI baseline page**.

Because of the limited availability of UTs for AMBER, it is recommended that any scientific programme on the UTs is designed so that scientifically meaningful results can be achieved in a single night.

6.13.1 Spectral Modes and Coverage

The following spectral modes are offered: the Low Resolution K band (LR-HK), Medium Resolution K band (MR-K), and High Resolution K band (HR-K). For period 84, we introduce a new mode, Medium Resolution H Band (MR-H). For central wavelengths and wavelength coverages for LR-HK, MR-K, MR-H and HR-K see **the AMBER web page.**

When using short DIT (smaller than 200 ms, see Sect. 6.13.2), only a limited spectral range can be recorded. Users interested in obtaining visibility measurements at several spectral positions inside the range allowed by each configuration can add up to two additional spectral bands.

6.13.2 Integration times, DIT

If no fringe tracker is used (*i.e.*, faint and/or extended objects, or airmass too high) the integration times with AMBER will have to be short to minimise atmospheric turbulence. For LR-HK and MR-K and MR-H, DITs are fixed to 25 ms on the UTs and 25 ms or 50 ms on the ATs if *absolute visibility* measurements are the goal. In HR-K it is assumed a DIT of 50 ms for absolute visibilities. For *closure-phase* and *differential-mode* the maximum allowed DIT is twice the DIT allowed in absolute mode. DITs longer than this can only be done in Visitor Mode (under exceptional weather conditions or if only closure-phase or differential-mode is the goal).

External fringe tracking with FINITO is available on both the UTs and the ATs. In this case, longer DITs are possible allowing *(i)* AMBER to use HR-K on the ATs and *(ii)* the full chosen spectral band in MR-K and HR-K to be read out.

6.13.3 Limiting magnitudes

Limiting magnitudes for AMBER are estimated assuming an unresolved source, *i.e.*, with a calibrated visibility of unity. Resolved sources will have lower limiting magnitudes corresponding to their visibility. Limiting magnitudes have been estimated under the assumption of 0.8″ (1.0″ on the ATs) seeing, and they can be significantly degraded as a result of atmospheric conditions. In particular for poor seeing and τ_0 (above 1.2″ and below 2.5 ms respectively), a loss of sensitivity of one magnitude or more can be expected.

Conversely, please note that the magnitudes are estimates on the basis of at least 50% of the frames being successfully processed by the AMBER pipeline. If a lower yield rate is accepted, an increase of up to 0.5 in the limiting magnitude can be achieved. In this case, the user might want to account for one or more repeated observations of the same spectral band in her/his proposal (see Sect. 6.13.5 below) to obtain more frames with sufficient SNR.

AMBER+FINITO limiting magnitudes are given considering that FINITO operations are only feasible for seeing below 1.2″, τ_0 above 2.5 ms, and Airmass below 1.5. The minimum target visibility **in the H-band** is 10% in all modes. The limiting correlated magnitude depends on the AMBER spectral resolution and the tracking mode. The main interest of FINITO Group-Tracking on faint magnitude is to enhance the SNR on the AMBER closure-phase.

The limiting correlated magnitudes are strongly dependent on the seeing and coherence times. The details of the limiting magnitude dependency on seeing can be found on **the AMBER web page:**. The most updated values on limiting magnitudes and details on the Visibility accuracy and Closure phase accuracy can be found in the instrument web pages.

We warn the user that *absolute visibility* calibration of the AMBER+FINITO data may be difficult if one of these parameters is close to the limit: seeing (1.2″), airmass (1.5), correlated H magnitude, or visibility in the H-band (10%). If more than two parameters are at the limit, the proposal will be declared unfeasible at technical evaluation.

6.13.4 Calibration strategies

AMBER requires frequent calibration on-sky, using calibrator stars. We offer two calibration modes: "CAL-SCI" and "CAL-SCI-CAL". The first one is the standard mode, which should be used if one is interested in *wavelength differential quantities*. "CAL-SCI-CAL", on the other hand, should be used if *absolute calibration* is required for best accuracy. This should be specified in the "calibration request" section of the proposal.

6.13.5 Execution times

The user should assume that 30 minutes (35 minutes for Period 83) are required for one measurement (i.e. a measurement of the science object **OR** a measurement of an interferometric calibrator star). This applies to all spectral modes with only one band. Each additional band in the observation adds 10 minutes to the total time. Hence a normal (one band) "CAL-SCI" cycle will take 60 minutes, whereas a "CAL-SCI-CAL" will take 90 minutes. Note that if FINITO is used, then the full wavelength range can be read out with the longer DITs and thus there is no need to add spectral bands. A maximum of 3 bands per observation is allowed. Please consult **the AMBER web pages** for more information.

7 Scientific Instruments: Chajnantor

7.1 SHFI

The APEX Swedish Heterodyne Facility Instrument SHFI contains 4 single pixel receivers:

- APEX-1: a Single Side Band (SSB) SIS receiver covering 211–275 GHz with SSB receiver temperature, $T_{\rm rec}$, around 130 K between 210 and 260 GHz and 180 K between 260 and 270 GHz. APEX-1 covers lower frequencies than previously offered at APEX, allowing observations during conditions with PWV>2 mm.
- APEX-2: a Single Side Band receiver covering 275–370 GHz with SSB receiver temperature, $T_{\rm rec}$, around 135 K. APEX-2 replaces the APEX-2A Double Side Band receiver, whose frequency coverage is assured by APEX-2 at similar sensitivity.
- APEX-3: this receiver is not offered in period 84.
- APEX-T2: a Double Side Band (DSB) HEB receiver operating at 1.25-1.39 THz with DSB $T_{\rm rec}$ around 1200 K. THz observations require excellent weather conditions (PWV <0.2 mm). APEX-T2 proposals should therefore be very short and concentrate on bright sources.

Further information on the SHFI receivers can be found on the **APEX instrumentation pages**. As backend, the Fast Fourier Transform Spectrometer (FFTS) has two units with a fixed bandwidth of 1 GHz, of which the central 900 MHz are usable. This allows users to cover up to 1.8 GHz instantaneous bandwidth. Spectral resolutions ranging from 976.56 ($\sim$0.92 km s^{-1}) to 122.07 kHz ($\sim$0.12 km s^{-1}) can be selected. For exposure time calculations, users should use the